

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To:

PCT

see form PCT/ISA220

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY (PCT Rule 43bis.1)

Applicant's or agent's file reference
see form PCT/ISA220

International application No
PCT/JP2004/003808

International filing date (day/month/year)
19 03 2004

Priority date (day/month/year)
20.03.2003

International Patent Classification (IPC) or both national classification and IPC
H01L21/336, H01L29/423, H01L29/786, H01L21/84, H01L27/12

Applicant
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Date of mailing
(day/month/year) see form PCT/ISA210 (second sheet)

FOR FURTHER ACTION See paragraph 2 below

1 This opinion contains indications relating to the following items:

- ☐ Box No I Basis of the opinion
- ☐ Box No II Priority
- ☒ Box No III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No IV Lack of unity of invention
- ☒ Box No V Reasoned statement under Rule 43bis 1(a)(i) with regard to novelty, inventive step or industrial applicability, citations and explanations supporting such statement
- ☐ Box No VI Certain documents cited
- ☐ Box No VII Certain defects in the international application
- ☐ Box No VIII Certain observations on the international application

2 FURTHER ACTION

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA"). However, this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66 1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of three months from the date of mailing of Form PCT/ISA220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA220

3 For further details, see notes to Form PCT/ISA220

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WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.
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Box No. I Basis of the opinion

1. With regard to the **language**, this opinion has been established on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.
 - ☐ This opinion has been established on the basis of a translation from the original language into the following language , which is the language of a translation furnished for the purposes of international search (under Rules 12.3 and 23.1(b)).
2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:
 - a. type of material:
 - ☐ a sequence listing
 - ☐ table(s) related to the sequence listing
 - b. format of material:
 - ☐ in written format
 - ☐ in computer readable form
 - c. time of filing/furnishing:
 - ☐ contained in the international application as filed.
 - ☐ filed together with the international application in computer readable form.
 - ☐ furnished subsequently to this Authority for the purposes of search.
3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
4. Additional comments:

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Box No. II Priority

1. ☒ The following document has not been furnished:

☒ copy of the earlier application whose priority has been claimed (Rule 43*bis*.1 and 66.7(a)).

☐ translation of the earlier application whose priority has been claimed (Rule 43*bis*.1 and 66.7(b)).

Consequently it has not been possible to consider the validity of the priority claim. This opinion has nevertheless been established on the assumption that the relevant date is the claimed priority date.

2. ☐ This opinion has been established as if no priority had been claimed due to the fact that the priority claim has been found invalid (Rules 43*bis*.1 and 64.1). Thus for the purposes of this opinion, the international filing date indicated above is considered to be the relevant date.

3. Additional observations, if necessary:

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Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non obvious), or to be industrially applicable have not been examined in respect of:

- ☐ the entire international application,
☒ claims Nos. 5

because:

- ☐ the said international application, or the said claims Nos. relate to the following subject matter which does not require an international preliminary examination (*specify*):
☒ the description, claims or drawings (*indicate particular elements below*) or said claims Nos. 5 are so unclear that no meaningful opinion could be formed (*specify*):

see separate sheet

- ☐ the claims, or said claims Nos. are so inadequately supported by the description that no meaningful opinion could be formed.
☐ no international search report has been established for the whole application or for said claims Nos.
☐ the nucleotide and/or amino acid sequence listing does not comply with the standard provided for in Annex C of the Administrative Instructions in that:
- | | |
|----------------------------|--|
| the written form | <input type="checkbox"/> has not been furnished |
| | <input type="checkbox"/> does not comply with the standard |
| the computer readable form | <input type="checkbox"/> has not been furnished |
| | <input type="checkbox"/> does not comply with the standard |
- ☐ the tables related to the nucleotide and/or amino acid sequence listing, if in computer readable form only, do not comply with the technical requirements provided for in Annex C-*bis* of the Administrative Instructions.
☐ See separate sheet for further details

**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.
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Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	6 - 8
	No: Claims	1 - 4, 9 - 11
Inventive step (IS)	Yes: Claims	
	No: Claims	1 - 4, 6 - 11
Industrial applicability (IA)	Yes: Claims	1 - 4, 6 - 11
	No: Claims	

2. Citations and explanations

see separate sheet

Re Item III

Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

It is not clear from **claim 5** or from the relevant passages of the description, which surface of the FIN is formed to have a convex shape and how this convex form is to be achieved. Therefore no comparison with the prior art is possible.

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

Reference is made to the following documents:

- D1:** US-A-4 996 574 (SHIRASAKI MASAHIRO) 26 February 1991 (1991-02-26)
- D2:** EP-A-0 623 963 (SIEMENS AG) 9 November 1994 (1994-11-09)
- D3:** US 2002/003256 A1 (MAEGAWA SHIGETO) 10 January 2002 (2002-01-10)
- D4:** US-B1-6 288 431 (IWASA SHOICHI ET AL) 11 September 2001 (2001-09-11)
- D5:** US-B1-6 413 802 (SUBRAMANIAN VIVEK ET AL) 2 July 2002 (2002-07-02)

1. The present application does not meet the criteria of **Article 33(1) PCT**, because the subject-matter of **claims 1 and 9 is not new in the sense of Article 33(2) PCT**.

1.1 The document **D1** (column 7, line 34 - column 8, line 15; claims 11-13; figures 10, 11) discloses (the references in parentheses applying to this document):

a semiconductor device comprising :
a semiconductor substrate (32) in which a trench (30) is formed;
a source region (31a) and a drain region (31b), each of which is buried in the trench and containing an impurity of the same conductive type;
a semiconductor FIN (31c) buried in the trench and provided between the source region and the drain region;
a gate insulating film (34) provided on a side surface of the semiconductor FIN as well as an upper surface of the semiconductor FIN; and
a gate electrode (35) provided on the gate insulation film, **which is relevant to claim 1.**

1.2 The document **D1** (column 7, line 34 - column 8, line 15; claims 11-13; figures 10, 11) discloses (the references in parentheses applying to this document):

a method for fabricating a semiconductor device, the device including a semiconductor substrate (32) in which a trench (30) is formed, a source region (31a) and a drain region (31b), each of which is buried in the trench and containing an impurity of the same conductive type, a semiconductor FIN (31c) buried in the trench and provided between

the source region and the drain region, a gate insulating film (34) provided on a side surface of the semiconductor FIN as well as an upper surface of the semiconductor FIN; and a gate electrode (35) provided on the gate insulation film, the method comprising the steps of:

- (a) forming a semiconductor layer in the trench formed in the semiconductor substrate;
- (b) forming a gate insulating film on an upper surface part of the semiconductor layer which is to be a semiconductor FIN as well as a side surface of the part of the semiconductor layer;
- (c) forming a gate electrode on the gate insulating film; and
- (d) introducing an impurity into the semiconductor layer, using the gate electrode as a mask, to form a source region and a drain region in regions of the semiconductor layer located on sides of and under the gate electrode, respectively, and then forming a semiconductor FIN in a region of the semiconductor layer interposed between the source region and the drain region and located directly under the gate electrode, **which is relevant to claim 9.**

1.3 Moreover, it should also be pointed out that **claims 1 and 9** are **not new** over the disclosure of document **D2** (the whole document), **D3** (page 6, paragraph 89 - 94; page 7, paragraph 100 - page 9, paragraph 123; claims; figures 1-23), **D4** (column 1, line 66 - column 2, line 34; column 3, line 35 - column 4, line 26; column 11, line 40 - column 13, line 58; column 18, line 42 - column 20, line 46; claims; figures 1-6) and **D5** (the whole document).

2. The present application does not meet the criteria of **Article 33(1) PCT**, because the subject-matter of **claim 6 does not involve an inventive step in the sense of Article 33(3) PCT.**

2.1 The document **D2** (the whole document) is regarded as being the closest prior art to the subject-matter of **claim 6**, and discloses (the references in parentheses applying to this document):

a semiconductor device comprising:

a first field-effect transistor including a semiconductor substrate (1,3) in which a trench is formed; a first source region (7) and a first drain region (7), each of which is buried in the trench and containing an impurity of the same conductive type, a semiconductor FIN (4) buried in the trench and provided between the first source region and the first drain region, a first gate insulating film (6) provided on a side surface of the semiconductor FIN as well as an upper surface of the semiconductor FIN; and a first gate electrode (5) provided on the gate insulation film.

The subject-matter of **claim 6** therefore differs from this known semiconductor device in that the devices further includes a standard MOSFET.

The problem to be solved by the present invention may therefore be regarded as how to integrate a FINFET and a MOSFET on a common substrate.

The document **D2** (column 4, line 28 - 35, claim 7) further discloses the integration of the semiconductor device together with standard semiconductor devices like CMOS-circuits.

It is therefore obvious to the person skilled in the art to include both devices on a common substrate, thereby arriving at the device disclosed in **claim 6**.

2.2 Moreover the integration of process compatible devices of different type on a common substrate is well known in the art and cannot be considered an inventive step, especially if both devices are already known and no novel or surprising technical effect is achieved.

3. Dependent **claims 2 - 4, 7 - 8 and 10 - 11** do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of novelty and or inventive step for the following reasons:

The use of Si as the FIN-material is disclosed in document **D1**. Furthermore the use of SiGe or SiGeC is well known in the art, which is relevant to **claim 2**.

The features of **claims 3, 4, 7 and 8** are disclosed in document **D1**.

The steps of **claim 10** are disclosed in document **D3** (page 8, paragraph 116; fig 18).

The steps of **claim 11** are disclosed in document **D1** (column 7, line 53 - 63; fig 10).